Factors Associated with Dual Form of Malnutrition in School Children in Nakhon Pathom and Bangkok

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Objective: *The present study examined the influence of family characteristics and maternal feeding practices on eating behaviors, food consumption and nutritional status of children living in 6 districts of Nakhon Pathom province and 3 surrounding districts of Bangkok.*

Material and Method: *One hundred and ninety nine families were enrolled in the present study. Four specific mother-child pair groups were purposively selected: 62 obese child/overweight mother pairs, 49 obese child/ normal weight mother pairs, 37 wasted child/overweight mother pairs, and 51 normal weight child/normal weight mother pairs. Anthropometric measurements were performed on all subjects. Biological data, socio-economic status, maternal feeding practices, as well as eating and lifestyle behaviors of the children were obtained from mothers and children using structured questionnaires and interviews.*

Result: *Most mothers from all groups, 40.8%-62.2%, had a primary education, were non-manual workers, with families containing 4-6 persons per household, and a family income of $\leq$ 20,000 baht per month. Multivariate logistic regression analysis showed that maternal overweight prior to pregnancy (OR11.85, 95%CI 2.16-64.99) child's high birth weight (OR 4.53, 95%CI 1.09-18.73) as well as maternal control over the consumption of high caloric food (OR13.07, 95%CI 4.08-41.86) and large amounts of food consumed by the children (OR12.58, 95%CI 4.30-36.80) were significant factors associated with childhood obesity. Compared to normal weight children, a higher proportion of obese children were not breast-fed and a higher proportion of normal weight mothers controlled the consumption of high caloric food in their obese children. Overweight mothers with wasted children also controlled their children's food intake. Higher proportion of wasted children had a higher snack consumption frequency but lower energy food intake than the normal weight children.*

Conclusion: *Understanding the underlying causes of dual form of malnutrition in the households would have implication for policy makers to address and implement a nutrition action plan. It is suggested that a malnutrition, (under and over-nutrition) prevention program must involve strategies within families that focus on providing nutrition education and the powerful guidance to help parents foster appropriate patterns of food choice and eating in their children. Promotion of increased physical activity in children is also essential. These strategies are aimed to promote the optimal child's weight and health.*

Keywords: *Dual form malnutrition, Obesity, Wasting children, Feeding practices*

As countries in Asia develop, changes in lifestyle and physical activity levels, the types of foods consumed, and the nutritional status of populations are becoming evident[1,2]. Taken together, they are culminating in a dual form of malnutrition, one where under-nutrition and over-nutrition co-exist within countries, communities, and even families. For example, over-

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nutrition has been shown to exist alongside under-nutrition in disadvantaged communities in China[3] and Brazil[4]. In Asia, while the nutritional status of mothers compared to that of their children differs among countries, the dual pattern of overweight mother-underweight child was being found at a rate of 12.6% in Malaysia, 3.4% in the Philippines, and 1.2% in Japan (unpublished multi-centre study data, Prof. Khor Geok Lin, Universiti Putra Malaysia, 2001). In Thailand, an unpublished 2001 study by Chittchang et al. from the Institute of Nutrition, Mahidol University indicated a prevalence of 7.0% among 21,462 pre-school children enrolled in government and private schools in Nakhon Pathom province.

Thailand has been undergoing "nutrition in transition" (from under-nutrition to over-nutrition) for the past two decades, along with concomitant changes in lifestyle and familial Socio-Economic Status (SES). In order to explore the nature of dual malnutrition as it is emerging within Thai families, the present study examined the influence of family characteristics and maternal feeding practices on eating behaviors, food consumption, and nutritional status of children.

Material and Method

This cross-sectional study was carried out between June 2003 and March 2004. The Committee on Human Rights Related to Human Experimentation, Mahidol University, approved the research design. The present study was conducted in 6 districts of Nakhon Pathom province, which is located in Central Thailand, about 51 kilometers northwest of Bangkok and included three surrounding districts of Bangkok. Nakhon Pathom province has a total estimated population of 807,264 people residing in 927 villages. The prevalence of obesity in primary school children is approximately 4.4%.

Subjects were children, aged between 6 to 10 years old, studying in grade 1-4. They were from twenty primary schools under the Nakhon Pathom Educational Service Areas 1 and 2 (Muang, Sampran, Nakhon Chaisri, Phuttamonthon, Kampang-san, and Banglane Districts) (enrolment of over 500 children) and nineteen primary schools under the Education Department, Bangkok Metropolitan Administration (Bangkae, Nongkaem and Talingchan Districts). Purposive sampling was used to obtain the number of subjects. Throughout the present study, the same researcher collected the weight and height measurements for all subjects. The weight of each subject was measured using a beam balance scale (Soehnle-Waagen Co., Germany;capacity of weighing range of 5-150 kg) to a precision of 100 g.

Height was measured with a microtoise (Stanley-Mabo Ltd., France, No. 191) to the nearest 0.1 cm. Bicep and triceps skinfold thickness measurements were taken twice using a skinfold caliper (Holtain Ltd., Crymych, UK) calibrated to the nearest 0.2 mm. Child nutritional status was categorized using weight-for-height Z score (WHZ), Thai reference. An obese child was defined by WHZ >+2SD, a normal weight child by a WHZ between-1.5SD and +1.5SD, and a wasted child by a WHZ<-1.5SD[5]. Mothers were categorized according to their body mass index (BMI, kg/m^2). A mother was defined as overweight when BMI $\geq$ 25.0 or of normal weight when the BMI was between 18.5-24.9 kg/m^2[6].

The screening of obese, normal weight and wasted children was conducted at each school. In addition, the children were asked to give their mothers' names and addresses. They were also shown an outline picture of different adult body shapes and were asked to choose which picture was the closest to their mother's body shape. Maternal body weight and height values were also collected through telephone interviews with the mothers, and these values were confirmed by weight and height measurements of the mothers at school.

Four mother-child pair groups were included in the present study, namely, obese child/overweight mother (group I), obese child/normal weight mother (group II), wasted child/overweight mother (group III), and normal weight child/normal weight mother (group IV). Information about each mother's pregnancy history was obtained from antenatal care records and mother interview, while information on each child's birth weight and length was obtained from the birth record of the hospital where the child was delivered. Information was gathered on subjects' families regarding Socio-Economic Status (SES), food consumption, and lifestyle behavior of children using structured questionnaires and interviews. The food consumption patterns of the children were assessed using a food frequency questionnaire, and 24-hour food recall for two days was also done. The children's physical activity levels, either sport, exercise or household tasks were assessed using structured physical activity questionnaires.

Definition of terms used in the present study

Breast feeding: Feeding with breast milk as the predominant sources. The infant might also have received water or water-based drinks, fruit juices or syrup forms vitamins and minerals, but no food-based was allowed to the infant[7].

Complementary food: Any nutrient-contained food such as ripe bananas, egg yolk, etc. were provided along with breast milk to infants aged more than 3-4 months.

Mother's control: Caring practices that involved 3 characteristics of mother's behaviors; (a) ordering the child to behave in a manner desirable to the mother such as telling the child not to consume too much food or forcing the child to consume more food, etc; (b) checking whether the child followed the mother's order or;(c) punishing the child if he/she did not follow the mother's order[8].

Data analysis

After data collection was completed, all questionnaires and record forms were checked and re-coded. Data were entered and analyzed using the Statistical Package for Social Science (SPSS, version 11.5). The chi-square test was applied to determine differences in independent variables (parental SES, child feeding practices, children's food consumption, and lifestyle behaviors) among the four mother-child pair groups. Analysis of variance and kruskat - wallis test, where appropriate were applied to determine significant differences among groups of mother-child pairs regarding continuous variables. Logistic regression analysis was used to determine factors associated with obesity or wasting in children. Analysis was based on all 199 children in the original sample. A p-value of less than 0.05 was considered to be a statistically significant difference.

Results

The anthropometric characteristics of the mothers and children are shown in Table 1. The mean age of mothers ranged between 33.4 and 37.2 years. The mean BMI of overweight mothers was 31.5 ± 4.5 kg/m^2 for group I and 28.3 ± 3.0 kg/m^2 for group III, significantly higher than that of normal weight mothers in group II and group IV. Mean biceps and triceps skin-

Table 1. Anthropometric parameters of subjects by mother-child pairs

Parameters	Groups			
	Obese child/ overweight mother (group I)	Obese child/ normal weight mother (group II)	Wasted child/ overweight mother (group III)	Normal weight child/ normal weight mother (group IV)
No. of subjects	62	49	37	51
Mothers				
Age (y)	37.2 ± 4.9^a	36.9 ± 5.8^b	34.8 ± 5.6	$33.4 \pm 4.9^{a,b}$
Weight (kg)	74.2 ± 14.1^a	$50.0 \pm 4.4^{a,b}$	$66.7 \pm 8.1^{a,b,c}$	50.2 ± 4.6^c
Height (cm)	154.5 ± 4.7	154.6 ± 5.4	153.4 ± 5.4	154.3 ± 4.9
BMI (kg/m^2)	31.5 ± 4.5^a	$20.9 \pm 1.2^{a,b}$	$28.3 \pm 3.0^{a,b,c}$	$21.1 \pm 1.3^{a,c}$
Biceps skinfold	16.8 ± 5.3^a	$7.29 \pm 2.0^{a,b}$	$12.3 \pm 3.3^{a,b,c}$	$6.20 \pm 1.9^{a,b,c}$
Triceps skinfold	28.4 ± 4.9^a	$16.0 \pm 3.5^{a,b}$	$23.9 \pm 4.2^{a,b,c}$	$15.2 \pm 3.3^{a,c}$
Children				
Male : Female	32:30	35:14	15:22	23:28
Age (y)	8.2 ± 1.1	8.2 ± 1.1	8.6 ± 1.2	8.2 ± 0.9
Weight (kg)	44.9 ± 8.7^a	43.4 ± 7.3^b	$19.8 \pm 3.6^{a,b,c}$	$24.2 \pm 3.9^{a,b,c}$
Height (cm)	132.4 ± 7.2^a	132.9 ± 7.2^b	$123.6 \pm 10.4^{a,b}$	$122.9 \pm 17.2^{a,b}$
WHZ score	3.49 ± 1.2^a	3.21 ± 1.0^b	$-1.95 \pm 0.5^{a,b,c}$	$-0.22 \pm 0.7^{a,b,c}$
WAZ score	3.54 ± 1.5^a	3.24 ± 1.2^b	$-1.84 \pm 0.6^{a,b,c}$	$-0.27 \pm 0.8^{a,b,c}$
HAZ score	1.27 ± 1.1^a	1.28 ± 1.0^b	$-0.90 \pm 1.1^{a,b,c}$	$-0.14 \pm 1.0^{a,b,c}$
Biceps skinfold	13.6 ± 3.5^a	13.0 ± 2.9^b	$3.57 \pm 0.8^{a,b,c}$	$5.06 \pm 1.6^{a,b,c}$
Triceps skinfold	22.8 ± 3.6^a	21.4 ± 3.4^b	$7.13 \pm 3.9^{a,b}$	$8.91 \pm 2.8^{a,b}$

Mean $\pm$ SD

[a,b,c] Values in the same row that were denoted with the same superscript letters were significantly different among groups at p < 0.05, by ANOVA for all parameters of children and for age and height variables of mothers. Significant mean differences among mother groups at p < 0.05 ,by non-parametric test (Kruskal Wallis) for body weight, BMI, biceps and triceps skinfolds variables

Table 2. Characteristics of mothers according to pregnancy history

Parameters	Groups			
	Obese child/ overweight mother (group I)	Obese child/ normal weight mother (group II)	Wasted child/ overweight mother (group III)	Normal weight child/ normal weight mother (group IV)
No. of subject	62	49	37	51
Mothers				
Pre-pregnancy weight (kg)	60.9±11.1[a,c,d]	48.2±7.6[a]	51.0±8.0[c]	47.0±6.5[d]
Pre-pregnancy BMI (kg/m²)	25.5±4.2[a]	20.1±2.5[a]	21.8±2.7[a,c]	19.9±2.4[a,c]
Weight gain during pregnancy (kg)	14.8±5.8[a,d]	12.8±4.5	10.9±4.2[a]	11.8±3.8[.d]
Children				
Birth weight (g)	3275.2±495.1[a]	3113.9±438.5	2924.3±462.1[a]	3028.0±353.0 [a]
Birth length(cm)	50.4±2.3[a]	50.3±2.7	48.7±2.6 [a]	49.9±2.3
Onset of child obesity(y)	4.98±7.5	3.57±2.4	-	-

Mean ± SD

[a,b,c] Values in the same row that were denoted with same superscript letters were significantly different among groups at p < 0.05, by ANOVA and by non-parametric (Kruskal Wallis) for birth length variables

fold thickness of overweight mothers was significantly greater than normal weight mothers. The mean age of the four children groups ranged between 8.2 and 8.6 years. Obese children in group I and group II showed significantly greater values of WHZ, WAZ and HAZ score than that of the wasted children (group III) and normal weight children (group IV). Both bicep and triceps skinfolds of obese children were significantly higher than that of normal weight and wasted children.

Table 2 shows that the overweight mothers in group I had significantly higher pre-pregnancy weight and BMI than the other three groups. Significantly higher weight gain during maternal pregnancy was also observed in group I compared to that of group III and group IV. Birth weight of obese children in group I was significantly higher than that of the wasted (group III) and normal weight children (group IV). Birth length of obese children in group I was also significantly higher than that of wasted children. The onset of the obesity in the child was between 3.5-4.9 years of age.

Familial demographic characteristics by specific groups of mother-child pairs are shown in Table 3. Most mothers (40.8%-62.2%) from all groups had a primary education. Most (54.9%-79.6%) worked as non-manual workers, with the highest proportion being normal weight mothers who had obese children. Regarding family size, most families (66.1%-67.6%) had 4 to 6 members per household, and 48.4%-59.5% had two children. Most of all groups, except for group II, earned an average monthly income of ≤ 10,000 baht per month.

Table 4 and Table 5 show the relationship between maternal feeding practices, children's eating behaviors and child nutritional status. From Table 4, a higher proportion of obese children from group I and II had a high birth weight, with a lower proportion being breast-fed when compared to that of the normal weight children. Most obese children (64.5% in group I and 57.1% in group II) consumed more than one dish at each meal. Normal weight mothers, who had obese children, tended to control more their children's consumption of high caloric food, and this feeding style was found to be significantly different among groups. In Table 5, a higher proportion of wasted children had a history of low birth weight. Overweight mothers tended to control food intake more in their wasted children than the normal weight mothers did, while wasted children consumed more snacks than normal weight children.

Multivariate logistic regression analysis (Table 6), was used to determine factors that influenced obesity in children. The initial model included gender and the gender x child's age interaction. The child's age variable, however, did not associate with the outcome and did not improve the fitness of model. For this reason, the child's age variable was dropped in the final model. Based on this analysis, maternal pre-pregnancy BMI, child's birth weight, maternal control over high caloric food by the child, and the amount of food the child consumed were the significant factors associated with obesity in children. For wasted children (Table 7),

Table 3. Demographic characteristic of families by mother-child pairs

	Groups				
	Obese child/ overweight mother (group I)	Obese child/ normal weight mother (group II)	Wasted child/ overweight mother (group III)	Normal weight child/normal weight mother (group IV)	p-value
No. of subjects	62	49	37	51	
Mother's education					
- Uneducated	1 (1.6)	0 (0)	2 (5.4)	0 (0)	0.186
- Primary school	29 (46.8)	20 (40.8)	23 (62.2)	31 (60.8)	
- Secondary school	18 (29.0)	8 (16.3)	9 (24.3)	12 (23.5)	
- Diploma	13 (21.0)	11 (22.4)	3 (8.1)	5 (9.8)	
- Bachelor degree or higher	1 (1.6)	10 (20.4)	0 (0)	3 (5.9)	
Mother's occupation					
Manual( )	24 (38.7)	10 (20.4)	16 (43.2)	23 (45.1)	0.047
Non-manual( )	38 (61.3)	39 (79.6)	21 (56.8)	28 (54.9)	
No. of household members					
- ≤ 3 persons	14 (22.6)	10 (20.4)	8 (21.6)	9 (17.6)	0.988
- 4-6 persons	41 (66.1)	33 (67.4)	25 (67.6)	34 (66.7)	
- ≥ 7 persons	7 (11.3)	6 (12.2)	4 (10.8)	8 (15.7)	
No. of child's siblings (included the child)					
One child	18 (29.0)	14 (28.6)	8 (21.6)	15 (29.4)	0.955
Two children	30 (48.4)	26 (53.1)	22 (59.5)	25 (49.0)	
≥ three children	14 (22.5)	9 (18.3)	7 (18.9)	11 (21.6)	
Child's birth order					
First	30 (48.4)	27 (55.1)	16 (43.2)	33 (64.7)	0.520
Second	23 (37.1)	19 (38.8)	17 (45.9)	14 (27.5)	
Third	8 (12.9)	2 (4.1)	3 (8.1)	4 (7.8)	
Fourth	1 (1.6)	1 (2.0)	1 (2.7)	0 (0)	
Family's monthly income (bahts)					
≤ 10,000	25 (40.3)	12 (24.5)	19 (51.4)	29 (56.8)	0.017*
10,001-20,000	18 (29.0)	21 (42.9)	15 (40.5)	14 (27.5)	
20,001-30,000	13 (21.0)	8 (16.3)	2 (5.4)	6 (11.8)	
> 30,000	6 (9.7)	8 (16.3)	1 (2.7)	2 (3.9)	

Values in the brackets represented percentage within group
( ) Included workers in the factories, agriculture and animal farming
( ) Included the ownership of trade/ business, instructor and persons with higher position of authority in the office
* By chi-square test, significantly different at $p < 0.05$

although maternal factors and child's low birth weight were not significant variables, univariate logistic regression analysis revealed that child's higher snack consumption frequency and inadequate energy intake were significantly associated with wasting in children.

Discussion

The co-existence of under-nutrition and over-nutrition within communities and families has come about as dietary patterns are shifting from energy deficient intake to excessive intake in children. The present study indicated that pre-pregnancy overweight among

mothers was associated with obesity in their children. This finding agreed with those of previous studies that have shown a relationship between parental obesity and the risk of childhood obesity[9,10] and this relationship is stronger among mothers as opposed to fathers[11]. The present study revealed that overweight mothers who had obese children were more commonly overweight before pregnancy compared to the other three groups. A previous study by Abrams et al[12] in women of different nutritional status indicated that both pre-pregnancy BMI and weight gain influenced birth weight and that maternal weight gain significantly

Table 4. Relationship between mothers' feeding practices, children's eating behaviors and physical activities, and child nutritional status

	Obese child/ overweight mother (group I)	Obese child/ normal weight mother(group II)	Normal weight child/ normal weight mother (group IV)	p-value
No. of subjects	62	49	51	
Child's birth weight				
< 3,500 g	43 (69.4)	41 (83.7)	47 (92.2)	0.008*
≥ 3,500 g	19 (30.6)	8 (16.3)	4 (7.8)	
Breast feeding practice				
No	20 (32.3)	8 (16.3)	5 (9.8)	0.009*
Yes	42 (67.7)	41 (83.7)	46 (90.2)	
> 12 months	7 (16.7)	1 (2.4)	8 (17.4)	0.064
≤ 12 months	35 (83.3)	40 (97.6)	38 (82.6)	
Age at which complementary food was introduced to the child				
≥ 4 months	20 (32.3)	22 (44.9)	15 (29.4)	0.223
< 4 months	42 (67.7)	27 (55.1)	36 (70.6)	
Mother's control over high caloric food in the child				
- Not control	38 (61.3)	21 (42.9)	47 (92.2)	0.005*
- Control	24 (38.7)	28 (57.1)	4 (7.8)	
Amount of food that child consumed in each meal when compared to other siblings				
- Could consume ≤ 1 dishes	22 (35.5)	21 (42.9)	45 (88.2)	0.005*
- Consumed > 1 dish	40 (64.5)	28 (57.1)	6 (11.8)	
Mother's control over child's snacking				
- Not control	36 (58.1)	24 (49.0)	34 (66.7)	0.201
- Control	26 (41.9)	25 (51.0)	17 (33.3)	
Child's consumption of snack & dessert( )				
- Consumption frequency score ≤ 10	41 (66.1)	35 (71.4)	33 (64.7)	0.751
- Consumption frequency score ≥ 11	21 (33.9)	14 (28.6)	18 (35.3)	
Food & snack consumption during TV viewing				
No	29 (46.8)	18 (36.7)	20 (39.2)	0.528
Yes	33 (53.2)	31 (63.3)	31 (60.8)	
Child's physical activity level( )				
≥ 1,500 MET-min/wk	47 (75.8)	36 (73.5)	37 (72.5)	0.919
< 1,500 MET-min/wk	15 (24.2)	13 (26.5)	14 (27.5)	
Time duration for TV viewing at the weekend (h/d)**	4.99±2.2	4.93±2.4	4.85±1.9	

Values in the brackets represented percentage within group

( ) Summation of consumption frequency of all types of snacks (including crispy snacks, bakery products, and desserts) in the previous week

( ) Summation of [MET level of type of sport, exercise, or household tasks x times per wk x duration in each occasion]

* By chi-square test, significantly different at $p < 0.05$

** Mean ± SD, No significant difference among groups, by ANOVA

increased birth weight. The present results showed that the mean birth weight among obese children whose mothers were overweight was significantly higher than that of wasted and normal weight children. In addition, a greater proportion of obese children had a birth weight of ≥ 3,500 g compared to normal weight children. This finding was consistent with previous studies[13,14] where the child's high birth weight correlated with overweight and obesity in later life.

Although the family's characteristics in terms of maternal education level and occupation were not significantly different among the four groups, the proportion of families of the obese children had higher income levels than the families of normal weight and

Table 5. Relationship between maternal feeding practices, children's eating behaviors and physical activities, and child nutritional status

	Wasted child/ overweight mother (group III)	Normal-weight child/ normal weight mother (group IV)	p-value
No. of subjects	37	51	
Child's birth weight			
$\geq$ 2,500 g	30 (81.1)	49 (96.1)	0.032*
< 2,500 g	7 (18.9)	2 (3.9)	
Breast feeding practice			
> 12 months	4 (11.4)	8 (17.4)	0.539
$\leq$ 12 months	31 (88.6)	38 (82.6)	
Age at which complementary food was first introduced to the child			
$\geq$ 4 months	7 (18.9)	15 (29.4)	0.262
< 4 months	30 (81.1)	36 (70.6)	
Most common food that mother prepared for her child			
- Rice with plain soup or boiled food	17 (46.0)	19 (37.3)	0.413
- Rice with curry, stirred fried food or Deep-fried food	20 (54.0)	32 (62.7)	
Mother's control over child's food intake (amount)			
- Not control	27 (73.0)	47 (92.2)	0.020*
- Control	10 (27.0)	4 (7.8)	
Mother's control over child's snacking			
- Not control	27 (73.0)	34 (66.7)	0.527
- Control	10 (27.0)	17 (33.3)	
Child's consumption of snack&dessert( )			
- Consumption frequency score $\leq$ 10	15 (40.5)	33 (64.7)	0.025*
- Consumption frequency score $\geq$ 11	22 (59.5)	18 (35.3)	
Child's performing of physical activity( )			
$\geq$ 1,500 MET-min/wk	28 (75.7)	37 (72.5)	0.742
< 1,500 MET-min/wk	9 (24.3)	14 (27.5)	

Values in the brackets represented percentage within group
( ) Summation of consumption frequency of all kinds of snacks (including crispy snacks, bakery products, and desserts) in the previous week
( ) Summation of [MET level of type of sport, exercise, or household tasks x times per wk x duration in each occasion]
* By chi-square test, significantly different at $p < 0.05$

wasted children. This finding was according to the study by Droomer et al in Indonesia[15] and by Sakamoto et al[16] in Saraburi province, Thailand. These studies indicated that overweight children were more common among families of high economic status. Although few studies have examined the actual mechanisms underlying this relation, a previous report demonstrated a higher household income contributed to improved access to food and increased caloric intake in children, particularly from meat and high fat foods[17]. A higher proportion of wasted children could be found in the second birth order. This may suggest inequalities in food allocation, a situation that is frequently observed in low income families[18]. The effect across family mem-

bers should be further explored in terms of how household size interacts with children's eating behaviors and impacts upon children's weight.

Regarding the relationship between maternal feeding practices and children's nutritional status, a lower proportion of obese children were breast-fed and with a shorter duration of breast feeding. A meta-analysis by Arenz et al[19] demonstrated that breast feeding significantly reduced the risk of obesity with an adjusted odds ratio of 0.78 (95%CI: 0.71,0.85) and that a longer duration of breast feeding was dose-dependent and inversely associated with the risk of being obese[20]. One possible explanation has been given that breast milk produced a lower plasma insulin response, thereby,

Table 6. Factors associated with obesity in children by multiple logistic regression (111 obese vs 51 normal weight children)

Covariates	Odds Ratio	95 % Confidence interval		p-value
		Lower	Upper	
Mother's pre-pregnancy BMI[a]	11.85	2.16	64.99	0.004*
Child's birth weight[b]	4.53	1.09	18.73	0.037*
Child's gender[c]	1.25	0.49	3.17	0.630
Family's monthly income[d]	2.10	0.64	6.86	0.217
Milk feeding[e]	2.82	0.74	10.69	0.126
Child's food consumption compared to other siblings[f]	12.58	4.30	36.80	0.005*
Mother's control over the child[g]	13.07	4.08	41.86	0.005*
Child's physical activity level[h]	0.37	0.01	7.49	0.518

Alphabet in each bracket was noted as reference group; a = mother's BMI $\leq$ 24.9, b = birth weight < 3,500 g, c = girl, d = family's monthly income $\leq$ 20,000 bahts, e = breast feeding, f = consumed $\leq$ 1 dish of food in each meal, g = didn't control over the child regarding high caloric food, h = child's physical activity at   600 MET-minutes per week
Prediction model: Goodness of fit =0.279, -2log likelihood = 120.59, Predicted R^2 = 80.7%
* Significant at $p < 0.05$

Table 7. Factors associated with wasting in children (37 wasted vs 51 normal weight children)

Variables	n	Odd ratio[ ]	95% Confidence interval	p- value
Mother's pre-pregnancy BMI				
18.5-24.9	68	1		
< 18.5	14	0.44	0.11-1.73	0.240
$\geq$ 25.0	6	3.23	0.55-18.9	0.193
Child's birth weight				
$\geq$ 2,500 g	79	1		
< 2,500 g	9	2.28	0.57-9.17	0.238
No. of sibling				
- Single child	23	1		
- 2 children or more	65	1.52	0.55-4.22	0.415
Mother's control over child's food intake				
- Not control	74	1		
- Control	14	2.61	0.82-8.36	0.105
Amount of food consumed by the child in each meal (compared to sibling)				
$\geq$ 1 dishes	37	1		
< 1 dish	51	0.98	0.41-2.34	0.956
Child's consumption of snack&dessert				
Consumption frequency score $\leq$ 10	48	1		
Consumption frequency score $\geq$ 11	40	2.69	1.11-6.55	0.029*
Child's energy intake				
$\geq$ 1,400 kcal/d	17	1		
< 1,400 kcal/d	71	5.81	1.24-27.34	0.015 *

[ ] By univariate logistic regression, * significant at $p < 0.05$

lower lipogenesis[21]. In addition, breast feeding leads to more internal control of energy intake by the child, whereas formula feeding was manipulated by parents. Overweight mothers with obese children in the present study had a lower percentage of breast feeding than the other groups. Li et al[22] demonstrated that women who were obese before pregnancy were less likely to initiate breast feeding than normal weight women did.

Obesity may impair the hypothalamic-pituitary-gonadal axis, consequently affecting milk production[23]. Women with large breasts, moreover, have difficulty in breast feeding or psychosocial factors related to obesity may play a role in failure to breast feed[24].

The results indicated that normal weight mothers tended to control the consumption of high caloric food in their obese children. Parents who attempt to shape a child's eating habits towards nutritionally desirable dietary outcomes, can have unintended consequences on child's eating behavior[25]. Evidence demonstrated that a high degree of parental control was associated with low self-regulatory food intake, hence, the promotion of overeating in children[26]. Wardle et al[27] have shown that obese and normal weight mothers did differ on control and that normal weight mothers reported significantly more control over their children's intakes. During television time, the presented data showed that over half of the children in each group consumed food and snacks while watching television. The mean viewing time of both obese and normal weight children was close to five hours per day during the weekend. Crespo et al[28] have reported that children watching television for more than four hours per day appeared to have an increased rate of obesity. Increased television viewing could also expose children to a large number of advertised unhealthy foods. One study[29] reported that approximately 26% of total daily energy was consumed during television viewing at the weekends and fat content of foods was associated with increased BMI in young children. No significant difference in the physical activity variable was observed between the two groups, suggesting obese children were as active as the normal weight children. This finding was in agreement with the study by Delany et al[30]. This study indicated that energy expenditure for physical activity was not lower in the obese than in the lean. Instead, they had higher absolute total energy expenditure. A previous study also showed that obese children tended to have a larger decrease in their metabolic rates during television viewing compared to normal weight children[31]. This implies that energy balance should be taken into account with regard to appropriate energy intake.

Compared to normal weight children, a greater proportion of wasted children had a low birth weight (< 2,500g), possibly due to maternal under-nutrition during pregnancy. Most mothers of wasted children reported that they commonly prepared rice with plain soup or boiled food rather than stir fried or deep-fried foods. They felt that their children were picky eaters and that a soft diet would be more easily consumed. During interviews, the children said that they often had no appetite at mealtime and preferred playing to eating. Higher snack consumption frequency and low energy intake from food were found to be the significant factors associated with wasting in children. A previous report showed that increased calories and total sugar content in snacks were related to decreased calories at subsequent meals[32] and that most children who ate snacks did not meet criteria of healthy nutrition[33].

Four significant factors were found to be associated with risk for obesity in children; ie: a mother who was overweight before pregnancy, high child's birth weight, mother's control over high caloric food and a large amount of food consumed by the child. Vogler et al[34] have proposed that most of the familial risks were likely to be explained by genetic factors. In addition, gene-environmental interactions would likely account for an increase in the prevalence of obese in children among obese mothers. This could be explained by feeding practices[35] and familial similarity in eating patterns[36]. Contanzo and Woody[37] introduced the concept of domain-specific parenting and indicated parental eating behavior also shaped children's eating behavior directly as a result of social modeling and by the choice of foods that were available to children. This assumption could not be fully investigated in the present cross-sectional study that precluded making a causal-effect inference on the association between maternal control and obesity in children. This issue is quite interesting, and a cohort study would be helpful in clarifying the mother-child interaction regarding food behaviors.

Conclusion

At a small scale level, the present study shows that high maternal pre-pregnancy BMI, high child's birth weight as well as maternal control over the consumption of high caloric food and large amounts of food by their children were significantly associated with obesity in children. High snack consumption and inadequate energy intake from the diet were associated with wasting in children. Family-based prevention programs must focus on guiding parents to foster correct child feeding patterns as well as to promote children's ability to self-regulate their food intake.

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ปัจจัยที่มีความสัมพันธ์กับภาวะทุพโภชนาการสองรูปแบบในเด็กวัยเรียนในจังหวัดนครปฐม และกรุงเทพฯ

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การวิจัยครั้งนี้เพื่อศึกษาลักษณะครอบครัวและอิทธิพลของการเลี้ยงดูของมารดาที่มีต่อพฤติกรรมการบริโภค และภาวะโภชนาการเด็ก กลุ่มตัวอย่างเป็นครอบครัวที่อาศัยอยู่ใน 6 อำเภอของจังหวัดนครปฐม และ 3 เขต ในกรุงเทพฯ จำนวน 199 ครอบครัว คือ ครอบครัวที่ลูกอ้วน/มารดาน้ำหนักตัวเกิน 62 คู่, ลูกอ้วน/มารดาน้ำหนักปกติ 49 คู่, ลูกผอม/ มารดาน้ำหนักตัวเกิน 37 คู่ และลูกน้ำหนักปกติ/มารดาน้ำหนักปกติ 51 คู่ ประเมินภาวะโภชนาการกลุ่มตัวอย่าง โดยชั่งน้ำหนัก วัดส่วนสูง และวัดไขมันใต้ผิวหนังที่ต้นแขนขวา ให้มารดาตอบแบบสอบถามและสัมภาษณ์เพิ่มเติม ข้อมูลประวัติครอบครัว ฐานะเศรษฐกิจ และพฤติกรรมการเลี้ยงดูและการให้อาหารเด็ก สัมภาษณ์เด็กเพื่อให้ทราบ พฤติกรรมบริโภคอาหารและกิจกรรมการใช้พลังงานของเด็ก

ผลการศึกษาพบว่าส่วนใหญ่, 40.8%-62.2%, ของมารดาจบการศึกษาระดับประถมศึกษาและมีอาชีพที่ ใช้แรงงานน้อยลง โดยเฉลี่ยมีสมาชิกในครอบครัว 4-6 คน ครอบครัวส่วนใหญ่มีรายได้น้อยกว่าหรือเท่ากับ 20,000 บาทต่อเดือน ผลจากการวิเคราะห์ โดย Multivariate logistic regression แสดงให้เห็นว่าแม่ที่น้ำหนักตัวเกิน ก่อนการตั้งครรภ์ (OR 11.85, 95%CI 2.16-64.99) น้ำหนักตัวแรกเกิดของเด็กที่มาก (OR4.53, 95%CI 1.09-18.73) การควบคุมของมารดาในการกินอาหารที่ให้พลังงานสูงของเด็ก (OR13.07, 95%CI 4.08-41.86) และปริมาณอาหาร มากที่เด็กกิน (OR12.58, 95%CI 4.30-36.80) มีความสัมพันธ์อย่างมีนัยสำคัญกับการเกิดภาวะอ้วนในเด็ก ข้อมูลประวัติการเลี้ยงดูเด็กพบว่าสัดส่วนของเด็กอ้วนที่ไม่ได้กินนมมารดามีมากกว่าเด็กปกติ และสัดส่วนที่มากกว่า ของมารดาปกติมีแนวโน้มที่จะควบคุม(ลด)การบริโภคอาหารพลังงานสูงในลูกที่อ้วนของตน นอกจากนี้ยังพบว่า เมื่อเปรียบเทียบกับมารดาปกติ มารดาที่น้ำหนักตัวเกินมีแนวโน้มที่จะควบคุม(เพิ่ม)ปริมาณอาหารให้ลูกที่ผอม กินเพิ่มขึ้น การศึกษายังพบว่าสัดส่วนเด็กผอมที่มีมากกว่าเด็กปกติจะกินขนมขบเคี้ยวในความถี่มากกว่าเด็กปกติ และพลังงานที่ได้รับจากอาหารต่อวันน้อยกว่าเกณฑ์มาตรฐานที่กำหนด ผลการศึกษานี้ชี้ให้เห็นว่าการเข้าใจ ปัจจัยสาเหตุที่มีความสัมพันธ์กับการเกิดภาวะโภชนาการเกินและขาดในเด็ก จะเป็นประโยชน์ต่อการวางแผน เชิงนโยบายและกลยุทธ์เพื่อนำไปสู่การป้องกันภาวะทุพโภชนาการทั้งสองแบบ กลยุทธ์ที่สำคัญในเด็กวัยเรียน ควรเน้นที่ครอบครัวโดยการให้โภชนศึกษาที่ถูกต้องในเชิงรุก รวมทั้งแนวทางปฏิบัติทางโภชนาการแก่ผู้ปกครอง เพื่อดูแลเด็กให้สามารถเลือกชนิดและบริโภคอาหารที่ถูกต้องและในปริมาณที่พอเหมาะกับวัย รวมทั้งส่งเสริมกิจกรรม การเคลื่อนไหวในเด็กเพิ่มขึ้น ทั้งนี้เพื่อช่วยให้เด็กมีน้ำหนักตัวที่เหมาะสมและสุขภาพที่ดี